In re Patent Application of: Shinya Kondoh

Serial No. 09/981,791 Examiner: Mengistu,Amare

Filed: October 19, 2001 Group Art Unit: 2673

For: ANTIFERROELECTRIC LIQUID CRYSTAL DISPLAY AND METHOD OF DRIVING THE SAME

OIPE JC102 AUG 2 3 2004 PATENT & TRADEMARK OFFICE

RECEIVED
AUG 3 0 2004
Technology Center 2600

TRANSLATOR'S DECLARATION

Honorable Commissioner of Patents & Trademarks
Washington, D.C. 20231

Sir:

I, Teruhisa Shimomichi , residing at c/o A. AOKI, ISHIDA & ASSOCIATES, Toranomon 37 Mori Bldg., 3-5-1, Toranomon Minato-ku, Tokyo 105-8423, Japan declare the following:

(1) That I know well both the Japanese and English languages;

(2) That I translated Japanese Patent Application No. 10-57689 , filed March 10, 1998 , from the Japanese language to the English language;

(3) That the attached English translation is a true and correct translation of the aforesaid Japanese Patent Application No. 10-57689 to the best of my knowledge and belief; and

(4) That all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements are made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001, and that such false statements may jeopardize the validity of the application or any patent issuing thereon.

June 24 , 2002

Date

Translator Teruhisa Shimomichi

[NAME OF DOCUMENT] APPLICATION FOR PATENT

[REFERENCE NUMBER] P-23998

[DATE FILED] March 10, 1998

[DESTINATION] To Commissioner, Patent Office;
Mr. Toshimitsu Arai

[INTERNATIONAL PATENT CLASSIFICATION] G02F 1/133

[TITLE OF THE INVENTION] ANTIFERROELECTRIC LIQUID CRYSTAL DISPLAY AND METHOD OF DRIVING THE SAME

[NUMBER OF CLAIMS] 4

[INVENTOR]

[Address or Residence] C/O CITIZEN WATCH CO., LTD. Technical Laboratory, 840, Aza Takeno, Oaza Shimotomi, Tokorozawa-shi, Saitama

[Name] Shinya Kondoh

[APPLICANT]

[Identification Number] 000019600

[Name of Applicant] CITIZEN WATCH CO., LTD.

[Representative] Hiroshi Haruta

[Phone Number] 03-3342-1231

[INDICATION OF FEES TO BE PAID]

[Registration Number for Prepayment] 003517

[Amount of Fee] 21000

[LIST OF ARTICLES TO BE SUBMITTED]

[Name of Article]	Specification	1
[Name of Article]	Drawing	1
[Name of Article]	Abstract	1

[NEED FOR PROOF] Yes

[NAME OF DOCUMENT] SPECIFICATION

[TITLE OF THE INVENTION] ANTIFERROELECTRIC LIQUID CRYSTAL DISPLAY AND METHOD OF DRIVING THE SAME

[SCOPE OF CLAIM FOR PATENT]

[CLAIM 1]

An antiferroelectric liquid crystal display comprising an antiferroelectric liquid crystal which is sandwiched between a pair of substrates having a plurality of scanning electrodes and signal electrodes on the opposing surfaces thereof, forming a matrix array of pixels, and which exhibits a first ferroelectric state, a second ferroelectric state which is a ferroelectric state achieved when a voltage of polarity opposite from said first ferroelectric state is applied, and an antiferroelectric state, wherein one cycle of writing to a pixel comprises at least one scanning period, and said scanning period comprises a selection period during which a select pulse for determining the amount of light transmission through said pixel is applied, a non-selection period for maintaining the amount of light transmission determined in said selection period, and a reset period for invariably resetting a display state to a predetermined state irrespective of display data, said antiferroelectric liquid crystal display being characterized in that said antiferroelectric liquid crystal display has a circuit configuration that can output, for an arbitrary period of time, a driving voltage waveform created so that a scanning voltage waveform to be applied during said selection period and a scanning voltage waveform to be applied during said non-selection period having equal peak values.

[CLAIM 2]

A driving method for an antiferroelectric liquid crystal display comprising an antiferroelectric liquid crystal which is sandwiched between a pair of substrates having a plurality of scanning electrodes and signal electrodes on the opposing surfaces thereof, forming a matrix array of pixels, and which exhibits a first ferroelectric state, a second ferroelectric

state which is a ferroelectric state achieved when a voltage of polarity opposite from said first ferroelectric state is applied, and an antiferroelectric state, wherein one cycle of writing to a pixel comprises at least one scanning period, and said scanning period comprises a selection period during which a select pulse for determining the amount of light transmission through said pixel is applied, a non-selection period for maintaining the amount of light transmission determined in said selection period, and a reset period for invariably resetting a display state to a predetermined state irrespective of display data, said method being characterized in that a driving voltage waveform, created so that a scanning voltage waveform to be applied during said selection period and a scanning voltage waveform to be applied during said non-selection period have equal peak values, is output for an arbitrary period of time.

[CLAIM 3]

An antiferroelectric liquid crystal display comprising an antiferroelectric liquid crystal which is sandwiched between a pair of substrates having a plurality of scanning electrodes and signal electrodes on the opposing surfaces thereof, forming a matrix array of pixels, and which exhibits a first ferroelectric state, a second ferroelectric state which is a ferroelectric state achieved when a voltage of polarity opposite from said first ferroelectric state is applied, and an antiferroelectric state, wherein one cycle of writing to a pixel comprises at least one scanning period, and said scanning period comprises a selection period during which a select pulse for determining the amount of light transmission through said pixel is applied, a non-selection period for maintaining the amount of light transmission determined in said selection period, and a reset period for invariably resetting a display state to a predetermined state irrespective of display data, said antiferroelectric liquid crystal display being characterized in that said antiferroelectric liquid crystal display has a circuit

configuration that can output, for an arbitrary period of time, a driving voltage waveform created so that a scanning voltage waveform to be applied during said selection period, a scanning voltage waveform to be applied during said non-selection period, and a scanning voltage waveform to be applied during said reset period all have equal peak values.

[CLAIM 4]

A driving method for an antiferroelectric liquid crystal display comprising an antiferroelectric liquid crystal which is sandwiched between a pair of substrates having a plurality of scanning electrodes and signal electrodes on the opposing surfaces thereof, forming a matrix array of pixels, and which exhibits a first ferroelectric state, a second ferroelectric state which is a ferroelectric state achieved when a voltage of polarity opposite from said first ferroelectric state is applied, and an antiferroelectric state, wherein one cycle of writing to a pixel comprises at least one scanning period, and said scanning period comprises a selection period during which a select pulse for determining the amount of light transmission through said pixel is applied, a non-selection period for maintaining the amount of light transmission determined in said selection period, and a reset period for invariably resetting a display state to a predetermined state irrespective of display data, said method being characterized in that a driving voltage waveform, created so that a scanning voltage waveform to be applied during said selection period, a scanning voltage waveform to be applied during said non-selection period, and a scanning voltage waveform to be applied during said reset period all have equal peak values, is output for an arbitrary period of time.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field of the Invention]

The present invention relates to an antiferroelectric liquid crystal display, such as a liquid crystal display panel or a liquid crystal optical shutter array, having a liquid

crystal layer of antiferroelectric liquid crystal and a matrix array of pixels.

[0002]

[Prior Art]

Liquid crystal panels using antiferroelectric liquid crystals have been researched extensively since it was reported, in Japanese Patent Unexamined Publication No. 2-173724 by Nippondenso and Showa Shell Sekiyu, that such liquid crystal panels provide wide viewing angles, are capable of fast response, and have good multiplexing characteristics.

[0003]

Figure 3 is a diagram of a liquid crystal cell construction showing the arrangement of polarizers when an antiferroelectric liquid crystal is used as a display. Between the polarizers 31, arranged in a crossed Nicol configuration, is placed a liquid crystal cell 32 in such a manner that the long axis direction of molecules in the absence of an applied voltage is oriented substantially parallel to the polarization axis of either one of the polarizers so that a black display can be produced when no voltage is applied and a white display can be produced when a voltage is applied. When a voltage is applied across the thus arranged liquid crystal cell, its transmittance varies with the applied voltage, describing a loop as plotted in the graph of Figure 4. The voltage value at which the transmittance begins to change when the applied voltage is increased is denoted by V1, and the voltage value at which the transmittance reaches saturation is denoted by V2, while the voltage value at which the transmittance begins to drop when the applied voltage is decreased is denoted by V5; on the other hand, when a voltage of opposite polarity is applied, the voltage value at which the transmittance begins to change when the absolute value of the applied voltage is increased is denoted by V3, and the voltage value at which the transmittance reaches saturation is denoted by V4, while the voltage value at which the transmittance begins to change when

the absolute value of the applied voltage is decreased is denoted by V6. Then, as can be seen Figure 3, when the voltage value is greater than the threshold of the antiferroelectric liquid crystal molecules, a first ferroelectric state or a second ferroelectric state is selected depending on the polarity of the applied voltage and, from these ferroelectric states, an antiferroelectric state is selected when the voltage value is lower than a certain threshold value.

[0004]

In a conventional antiferroelectric liquid crystal display driving method, as shown in Figure 5, it has been practiced to select the first or the second ferroelectric state or the antiferroelectric state in a selection period (Se) and to maintain the selected state throughout the following non-selection period (NSe). That is, it has been practiced to produce a display by maintaining throughout the non-selection period (NSe) the light transmittance achieved by the application of a select pulse in the preceding selection period (Se).

[0005]

Here, if the molecular state of the antiferroelectric liquid crystal, immediately before the application of the select pulse in the selection period, is different, it is difficult to control the light transmittance of the pixel accurately to a designated value; in view of this, it has often been practiced to invariably reset the state to the antiferroelectric state prior to the application of the select pulse, irrespective of the previous display state of that pixel. Several methods of resetting have been practiced: in one method, resetting to the antiferroelectric state is accomplished by setting the voltage value in the reset period to 0 V and letting the liquid crystal spontaneously relax back to the antiferroelectric state by the viscosity, elasticity, or another property that the antiferroelectric liquid crystal inherently has, and in another method, the liquid crystal is

reset to the antiferroelectric state by applying an appropriate voltage.

[0006]

An antiferroelectric liquid crystal used in an antiferroelectric liquid crystal display forms a layer structure with layers called smectic layers within a liquid crystal panel and, as shown in Figure 6, the geometry of this layer structure changes according to the applied voltage waveform.

[0007]

Immediately after the liquid crystal is injected into the liquid crystal panel, the layer structure is a chevron structure with the layers bent in the middle between the top and bottom glass substrates, as shown in Figure 6-a; then, when a layer structure controlling voltage waveform is applied, the layer structure changes to the bookshelf structure with the layers lying perpendicular to the top and bottom substrates, as shown in Figure 6-b. However, if the temperature changes thereafter, causing a change in the smectic layer spacing, the layer structure changes back to a structure similar to the initial chevron structure, as shown in Figure 6-c; in this condition, when a display voltage waveform for producing a white display is applied to the liquid crystal cell, the layer structure changes to a quasi-bookshelf structure close to the bookshelf structure, but in the case of a display voltage waveform for producing a black display, the layer structure remains substantially unchanged and the layer structure shown in Figure 6-c is retained.

[0008]

Since this difference in the layer structure results in a difference in the state of light passing through the liquid crystal panel and is recognized as an image sticking state to the human eye, it has been proposed, in the prior art, to apply a layer structure controlling voltage waveform each time the layer structure changes in order to eliminate this image sticking state; for this purpose, in Japanese Patent

Unexamined Publication No. 6-20207, a layer structure controlling drive circuit is provided separately from the display drive circuit, and the layer structure controlling driving voltage waveform is applied to the liquid crystal panel in order to prevent the image sticking.

[0009]

[Problems to be Solved by the Invention]

However, since the layer structure controlling voltage waveform differs in frequency and in peak value from the display voltage waveform, a clock generating circuit, voltage value conversion circuit, etc. have had to be provided for the layer structure controlling drive circuit, separately from those for the display driving circuit; as a result, two circuits, i.e., the display drive circuit and the layer structure controlling circuit, have had to be provided for one liquid crystal display, increasing not only the manufacturing cost but also the size and complexity of the liquid crystal display circuitry. It is, accordingly, an object of the present invention to provide an antiferroelectric liquid crystal display that has a display drive circuit configured to output a layer structure controlling voltage waveform, thereby eliminating the need to provide a layer structure controlling circuit separately, and to achieve drive circuitry compact in configuration and inexpensive to manufacture compared with the prior art.

[0010]

[Means for Solving the Problems]

To achieve the above object, the following means have been used in the present invention.

[0011]

An antiferroelectric liquid crystal display according to the invention described in claim 1 comprises an antiferroelectric liquid crystal which is sandwiched between a pair of substrates having a plurality of scanning electrodes and signal electrodes on the opposing surfaces thereof, forming a matrix array of pixels, and which exhibits a first

ferroelectric state, a second ferroelectric state which is a ferroelectric state achieved when a voltage of polarity opposite from the first ferroelectric state is applied, and an antiferroelectric state, wherein one cycle of writing to a pixel comprises at least one scanning period, and the scanning period comprises a selection period during which a select pulse for determining the amount of light transmission through the pixel is applied, a non-selection period for maintaining the amount of light transmission determined in the selection period, and a reset period for invariably resetting a display state to a predetermined state irrespective of display data, the antiferroelectric liquid crystal display being characterized in that the antiferroelectric liquid crystal display has a circuit configuration in which a driving voltage waveform, created so that a scanning voltage waveform to be applied during the selection period and a scanning voltage waveform to be applied during the non-selection period both have equal peak values, is applied as a layer structure controlling voltage waveform, for an arbitrary period of time, from a display drive circuit.

A driving method according to the invention described in claim 2 is a driving method for an antiferroelectric liquid crystal display comprising an antiferroelectric liquid crystal which is sandwiched between a pair of substrates having a plurality of scanning electrodes and signal electrodes on the opposing surfaces thereof, forming a matrix array of pixels, and which exhibits a first ferroelectric state, a second ferroelectric state which is a ferroelectric state achieved when a voltage of polarity opposite from the first ferroelectric state is applied, and an antiferroelectric state, wherein one cycle of writing to a pixel comprises at least one scanning period, and the scanning period comprises a selection period during which a select pulse for determining the amount of light transmission through the pixel is applied, a non-selection period for maintaining the amount of light transmission determined in the selection period, and a reset

period for invariably resetting a display state to a predetermined state irrespective of display data, the method being characterized in that a driving voltage waveform, created so that a scanning voltage waveform to be applied during the selection period and a scanning voltage waveform to be applied during the non-selection period both have equal peak values, is output as a layer structure controlling voltage waveform, for an arbitrary period of time, from a display drive circuit.

An antiferroelectric liquid crystal display according to the invention described in claim 3 comprises an antiferroelectric liquid crystal which is sandwiched between a pair of substrates having a plurality of scanning electrodes and signal electrodes on the opposing surfaces thereof, forming a matrix array of pixels, and which exhibits a first ferroelectric state, a second ferroelectric state which is a ferroelectric state achieved when a voltage of polarity opposite from the first ferroelectric state is applied, and an antiferroelectric state, wherein one cycle of writing to a pixel comprises at least one scanning period, and the scanning period comprises a selection period during which a select pulse for determining the amount of light transmission through the pixel is applied, a non-selection period for maintaining the amount of light transmission determined in the selection period, and a reset period for invariably resetting a display state to a predetermined state irrespective of display data, the antiferroelectric liquid crystal display being characterized in that the antiferroelectric liquid crystal display has a circuit configuration in which a driving voltage waveform, created so that a scanning voltage waveform to be applied during the selection period, a scanning voltage waveform to be applied during the non-selection period, and a scanning voltage waveform to be applied during the reset period all have equal peak values, is output as a layer structure controlling voltage waveform, for an arbitrary period of time, from a display drive circuit.

A driving method according to the invention described in claim 4 is a driving method for an antiferroelectric liquid crystal display comprising an antiferroelectric liquid crystal which is sandwiched between a pair of substrates having a plurality of scanning electrodes and signal electrodes on the opposing surfaces thereof, forming a matrix array of pixels, and which exhibits a first ferroelectric state, a second ferroelectric state which is a ferroelectric state achieved when a voltage of polarity opposite from the first ferroelectric state is applied, and an antiferroelectric state, wherein one cycle of writing to a pixel comprises at least one scanning period, and the scanning period comprises a selection period during which a select pulse for determining the amount of light transmission through the pixel is applied, a non-selection period for maintaining the amount of light transmission determined in the selection period, and a reset period for invariably resetting a display state to a predetermined state irrespective of display data, the method being characterized in that a driving voltage waveform, created so that a scanning voltage waveform to be applied during the selection period, a scanning voltage waveform to be applied during the non-selection period, and a scanning voltage waveform to be applied during the reset period all have equal peak values, is output as a layer structure controlling voltage waveform, for an arbitrary period of time, from a display drive circuit.

[0015]

(Operation)

According to a study by the inventors, it has been found that a rectangular wave is the most suitable type of voltage waveform (layer structure controlling voltage waveform) used to cause the layer structure of the antiferroelectric liquid crystal to change from the chevron structure (Figure 6-a) to the bookshelf structure (Figure 6-b), and also that a low frequency in the range from about 100 Hz to 1 Hz and a voltage value in the range of 10 V to 50 V, that does not cause

dielectric breakdown between the top and bottom glass substrates of the liquid crystal panel, are suitable for the voltage waveform.

[0016]

The frequency of the display driving voltage waveform for the antiferroelectric liquid crystal is about 30 Hz to 70 Hz, depending on the display panel used. The voltage applied during the selection period is about 30 V.

[0017]

The voltage (holding voltage) applied during the non-selection period is usually around 10 V, but it has been discovered that when the peak value of the voltage applied during the non-selection period is made equal to the peak value of the voltage applied during the selection period, a voltage waveform close to the optimum layer structure controlling voltage waveform obtained in the study can be produced.

[0018]

In view of this, the inventors have provided switches by which the peak value level of the voltage to be applied during the non-selection period can be selected from two levels.

[0019]

Furthermore, when the peak value of the voltage waveform is made the same for all the periods (selection period, non-selection period, and reset period) in one frame, the voltage waveform can be made much closer to optimum layer structure controlling voltage waveform.

[0020]

[Embodiments of the Invention]

Embodiments of the present invention will be described in detail below with reference to the accompanying drawings.

[0021]

As shown in Figure 1, an antiferroelectric liquid crystal display according to the present invention comprises a driving voltage waveform control circuit 11 for controlling a driving voltage waveform, a display data generating circuit 12, a

scanning voltage output circuit 13, a signal voltage output circuit 14, and a power supply circuit 15. The power supply circuit produces DC voltages of seven different levels necessary to create scanning voltage waveforms and signal voltage waveforms, and the voltages of the respective values are supplied at appropriate timings from the scanning voltage output circuit 13 and signal voltage output circuit 14 to the liquid crystal panel.

[0022]

In the power supply circuit, +VS and -VS to be output from the scanning voltage output circuit during the selection period and +VO and -VO to be output during the non-selection period are connected to a switch circuit as shown in Figure 2, and the outputs ±VO are coupled as needed to the outputs ±VS so that ±VS can be output from the ±VO output terminals.

[0023]

A temperature sensor 79 for measuring the temperature at the surface of the liquid crystal panel is attached to the surface of the liquid crystal panel so that the temperature at the surface of the liquid crystal panel can be measured; information from this temperature sensor 79 is input to the power supply circuit, and which voltages, ±VS or ±VO, are to be output from the ±VO output terminals are automatically selected depending on the temperature and other conditions.

[0024]

If the peak value of the scanning voltage waveform is made the same for all the periods (selection period, non-selection period, and reset period) in one frame, a more effective layer structure controlling voltage waveform can be produced; in view of this, the inventors have made provisions so that the length of the reset period can be controlled by the driving voltage waveform control circuit 11 and can be reduced down to 0 in order to produce a scanning voltage waveform consisting only of a selection period and a non-selection period, in one frame, by apparently eliminating the reset period.

[0025]

Figure 7 shows the structure of the liquid crystal panel used in the present invention; as shown, the liquid crystal panel comprises: a pair of glass substrates 73a and 73b between which an antiferroelectric liquid crystal layer 72 with a thickness of about 2 μm is sandwiched; and a sealing member 76 for bonding the two glass substrates together. On the opposing surfaces of the glass substrates are formed electrodes 74a and 74b, which are coated with polymeric alignment films 75a and 75b, and are treated by rubbing. On the outside surface of one glass substrate is disposed a first polarizer 71a with its polarization axis oriented parallel to the rubbing axis, while on the outside surface of the other glass substrate, a second polarizer 71b is arranged with its polarization axis oriented at 90° to the polarization axis of the first polarizer 71a.

[0026]

In the power supply circuit for the antiferroelectric liquid crystal display, an AC-DC conversion circuit converts an ordinary AC voltage to a prescribed DC voltage (5 V), and a DC voltage conversion circuit creates from the thus converted DC voltage a DC voltage of about ±30 V, a DC voltage of about ±7 V, and a DC voltage of about ±6 V necessary for the signal voltage.

[0027]

In the present invention, normally, the driving waveform shown in Figure 5 is applied to produce the display but, when the panel temperature drops below 10°C and then rises again above 10°C, a scanning voltage waveform whose one frame period (the sum of the reset period, selection period, and non-selection period) is about 17 ms, and in which the peak value of the voltage waveform applied during the selection period and the peak value of the voltage waveform applied during the non-selection period are both set to ±30 V, as shown in Figure 8, is applied as the layer structure controlling voltage waveform to the liquid crystal panel for about one second in

order to alleviate the image sticking phenomenon occurring due to the change in the geometry of the layer structure.

[0028]

When the controlling voltage waveform is applied as described above, the change in the geometry of the layer structure due to the temperature change is corrected, and the image sticking does not occur on the display. Further, the application of the layer structure controlling voltage waveform has little effect on the display appearance, as the application time was very short.

[0029]

Further, when a scanning voltage waveform such as shown in Figure 9, in which the peak value of the voltage waveform applied during the selection period and the peak value of the voltage waveform applied during the non-selection period are both set to ±30 V and the reset period was set to 0, was applied as the layer structure controlling voltage waveform, the image sticking on the display could likewise be reduced.

[0030]

[ADVANTAGEOUS EFFECT OF THE INVENTION]

As described above with reference to the embodiment of the present invention, the peak value of the voltage waveform applied during the selection period is set equal to the peak value of the voltage waveform applied during the non-selection period and, by using the thus created waveform as the layer structure controlling voltage waveform, the image sticking phenomenon occurring due to a change in the geometry of the layer structure can be alleviated and a good display can be produced without degrading the display quality. Furthermore, an antiferroelectric liquid crystal display can be achieved that has a low cost and a compact circuit configuration compared with the prior art.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Figure 1]

Figure 1 is a circuit block diagram of an embodiment of the present invention.

[Figure 2]

Figure 2 is a diagram showing the configuration of a power supply according to the embodiment of the present invention.

[Figure 3]

Figure 3 is a diagram showing the arrangement of a liquid crystal cell and polarizers according to the present invention.

[Figure 4]

Figure 4 is a diagram showing a hysteresis curve for an antiferroelectric liquid crystal display device according to the present invention.

[Figure 5]

Figure 5 is a diagram showing a driving method according to the prior art.

[Figure 6]

Figure 6 is a diagram showing a layer structure of an antiferroelectric liquid crystal according to the present invention.

[Figure 7]

Figure 7 is a diagram showing the structure of the liquid crystal panel used in the present invention.

[Figure 8]

Figure 8 is a diagram showing the layer structure controlling voltage waveform used in the embodiment.

[Figure 9]

Figure 9 is a diagram showing the layer structure controlling voltage waveform, having no reset periods, used in the embodiment.

[DESCRIPTION OF THE REFERENCE CHARACTERS]

OFF(B) BLACK DISPLAY

ON(W) WHITE DISPLAY

SC1 FIRST SCANNING PERIOD

SC2 SECOND SCANNING PERIOD

Rs RESET PERIOD

Se SELECTION PERIOD

NSe NON-SELECTION PERIOD

Xn SCANNING ELECTRODE

Ym SIGNAL ELECTRODE

Anm PIXEL

T LIGHT TRANSMITTANCE

31a, 31b POLARIZER

32 LIQUID CRYSTAL CELL

71a, 71b POLARIZER

72a, 72b ANTIFERROELECTRIC LIQUID CRYSTAL

73a, 73b GLASS SUBSTRATE

74a, 74b ELECTRODE

75a, 75b POLYMERIC ALIGNMENT FILM

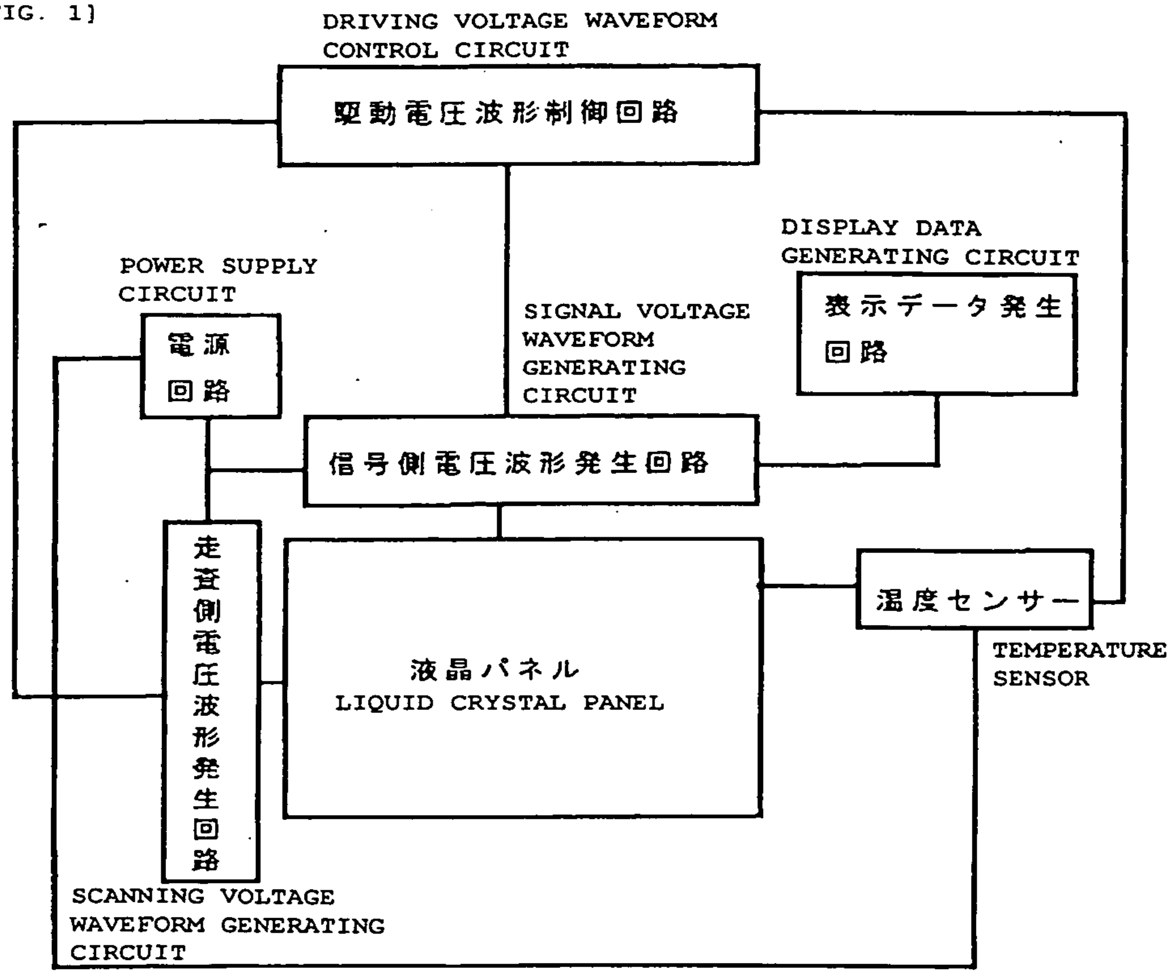
76 SEALING MEMBER

78 BACKLIGHT

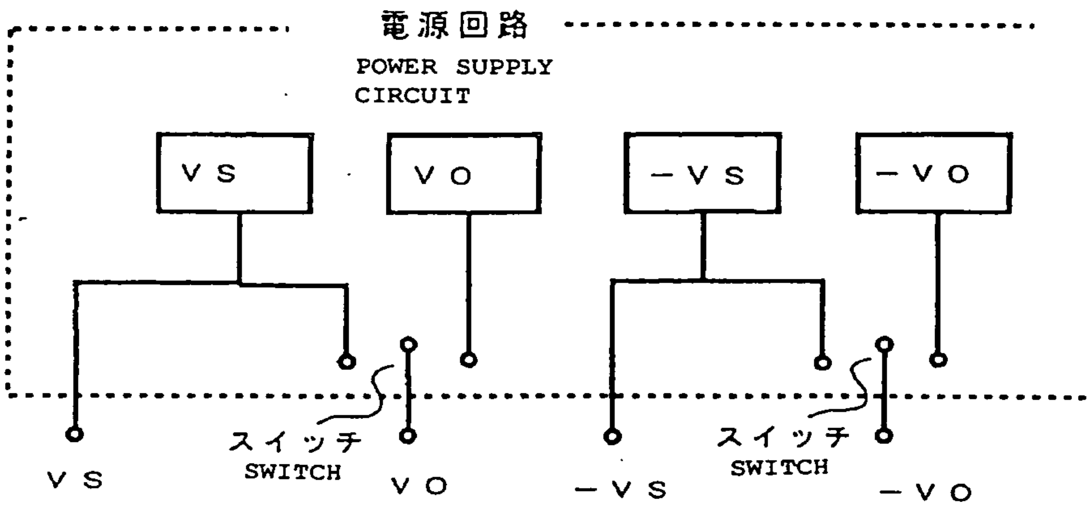
79 TEMPERATURE SENSOR

【書類名】　図面
[NAME OF DOCUMENT]　DRAWINGS

【図１】
[FIG. 1]

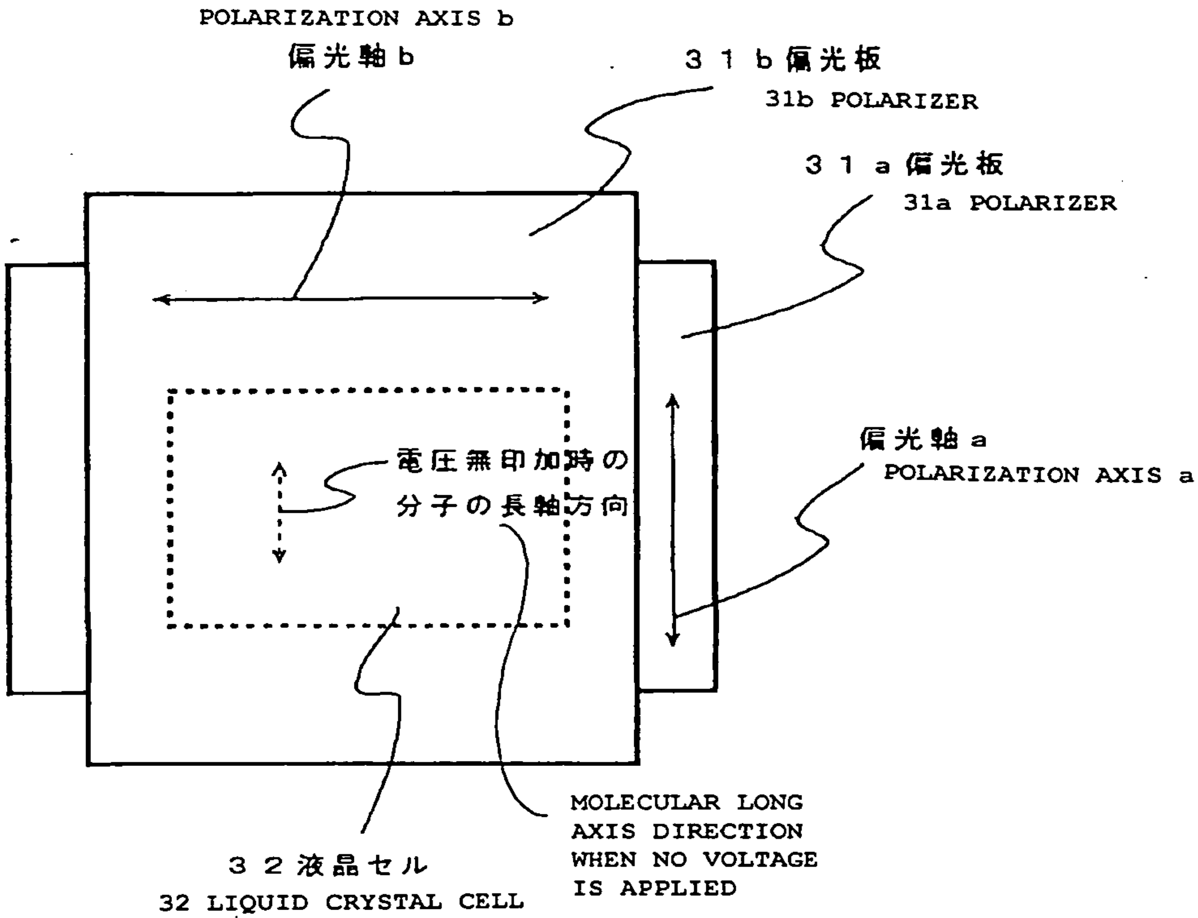


【図２】
[FIG. 2]

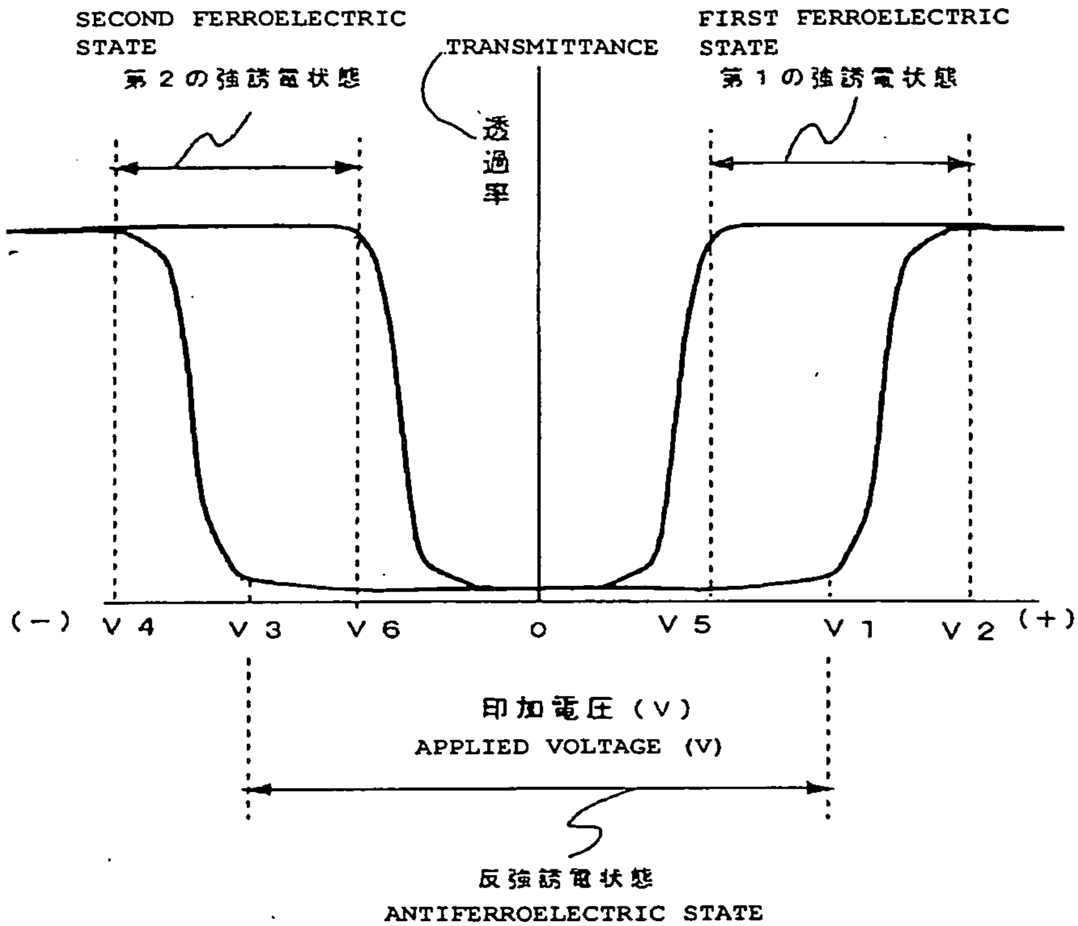


電源回路
POWER SUPPLY CIRCUIT
ＶＳ
ＶＯ
－ＶＳ
－ＶＯ
スイッチ
SWITCH
ＶＳ
ＶＯ
－ＶＳ
スイッチ
SWITCH
－ＶＯ

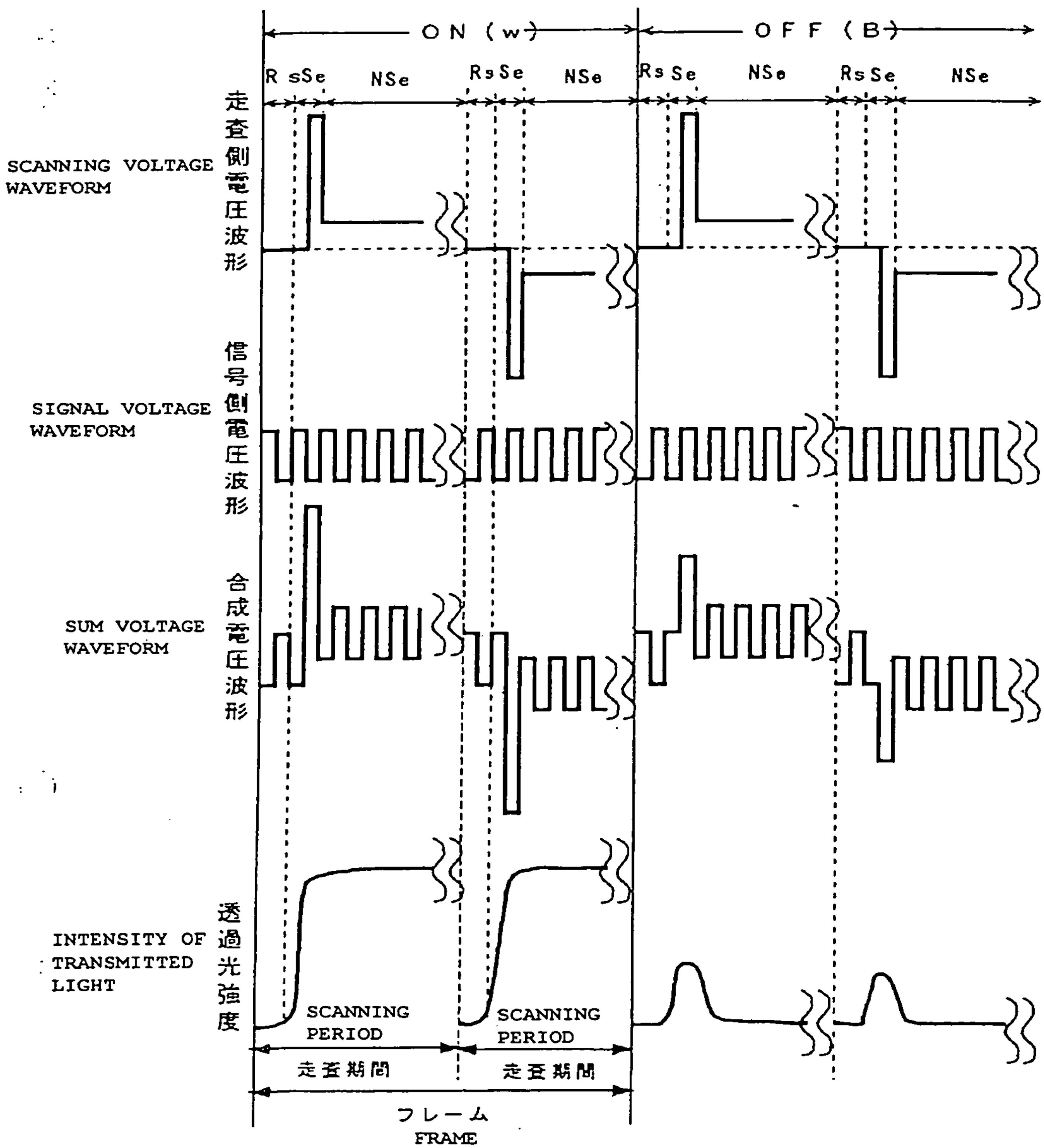
【図３】
[FIG. 3]


POLARIZATION AXIS b
偏光軸ｂ
３１ｂ偏光板
31b POLARIZER
３１ａ偏光板
31a POLARIZER
偏光軸ａ
POLARIZATION AXIS a
電圧無印加時の
分子の長軸方向
MOLECULAR LONG
AXIS DIRECTION
WHEN NO VOLTAGE
IS APPLIED
３２液晶セル
32 LIQUID CRYSTAL CELL

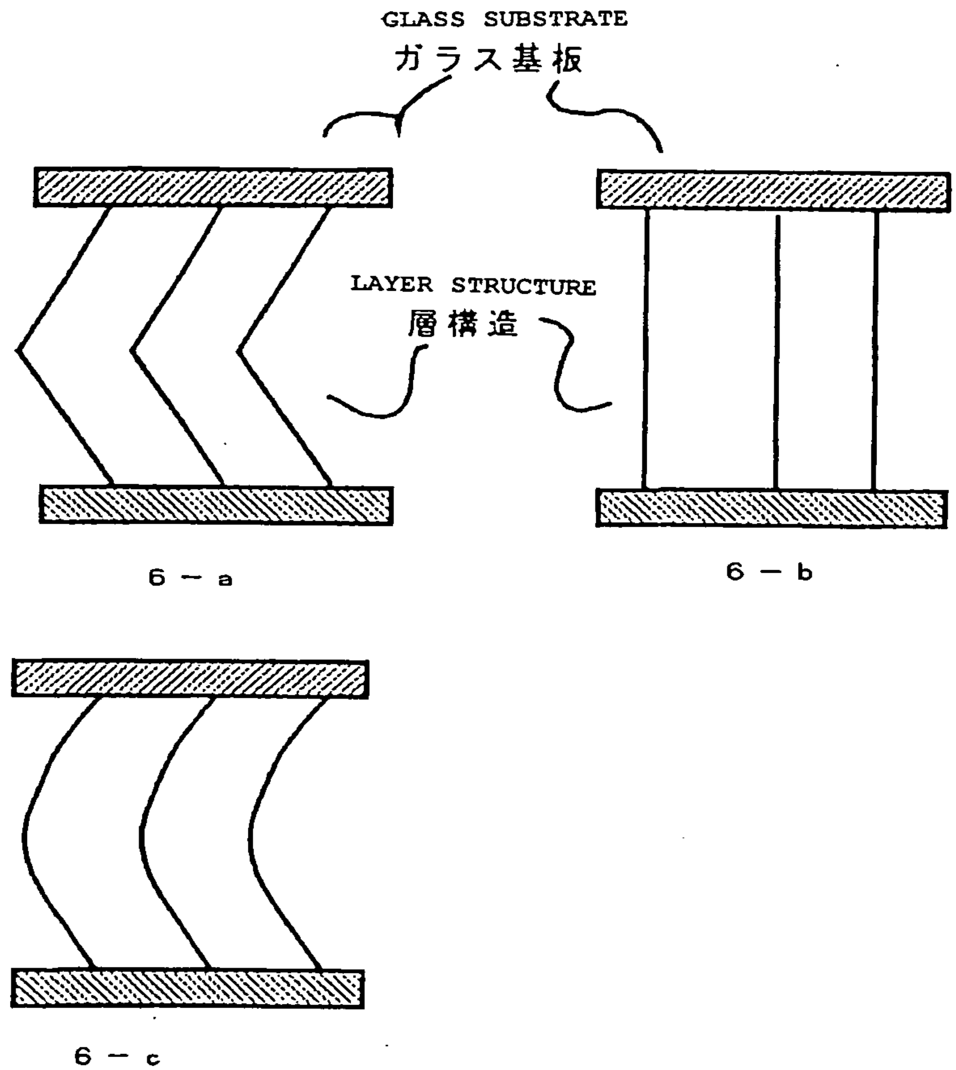
【図４】
[FIG. 4]


SECOND FERROELECTRIC STATE
第２の強誘電状態
TRANSMITTANCE
透過率
FIRST FERROELECTRIC STATE
第１の強誘電状態
(−)
V4
V3
V6
0
V5
V1
V2
(+)
印加電圧（V）
APPLIED VOLTAGE (V)
反強誘電状態
ANTIFERROELECTRIC STATE

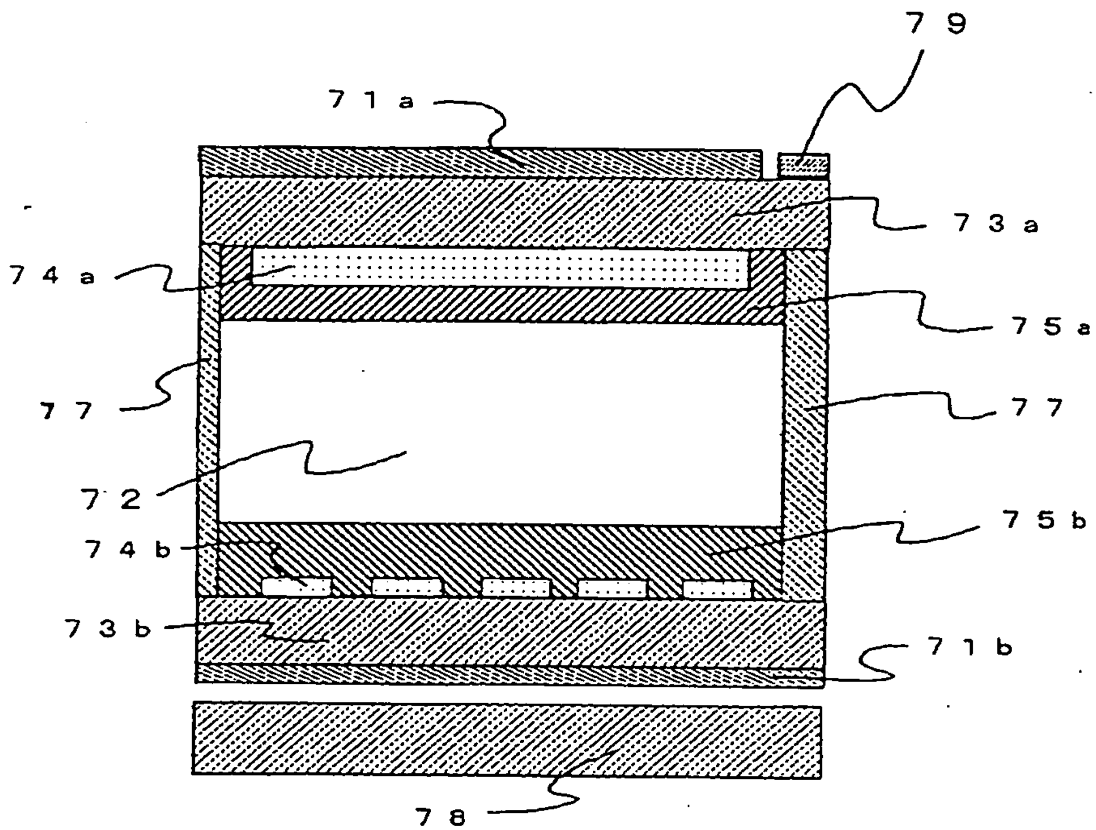
【図５】
[FIG. 5]


ON (w)
OFF (B)
R sSe
NSe
RsSe
NSe
RsSe
NSe
RsSe
NSe
SCANNING VOLTAGE WAVEFORM
走査側電圧波形
SIGNAL VOLTAGE WAVEFORM
信号側電圧波形
SUM VOLTAGE WAVEFORM
合成電圧波形
INTENSITY OF TRANSMITTED LIGHT
透過光強度
SCANNING PERIOD
走査期間
SCANNING PERIOD
走査期間
フレーム
FRAME

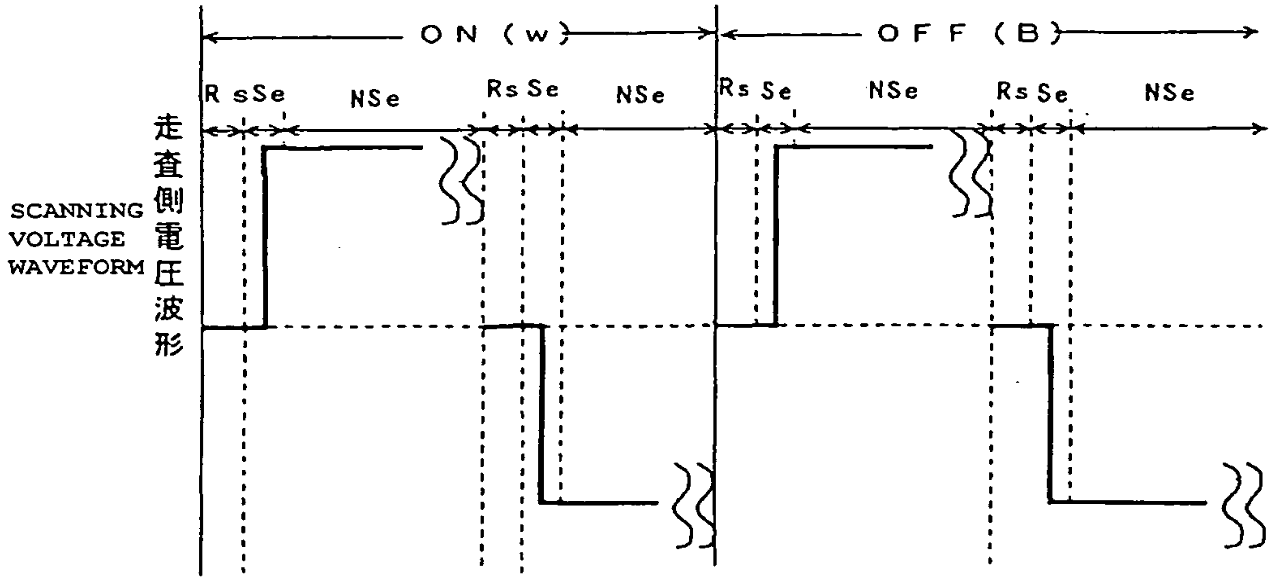
【図６】
[FIG. 6]



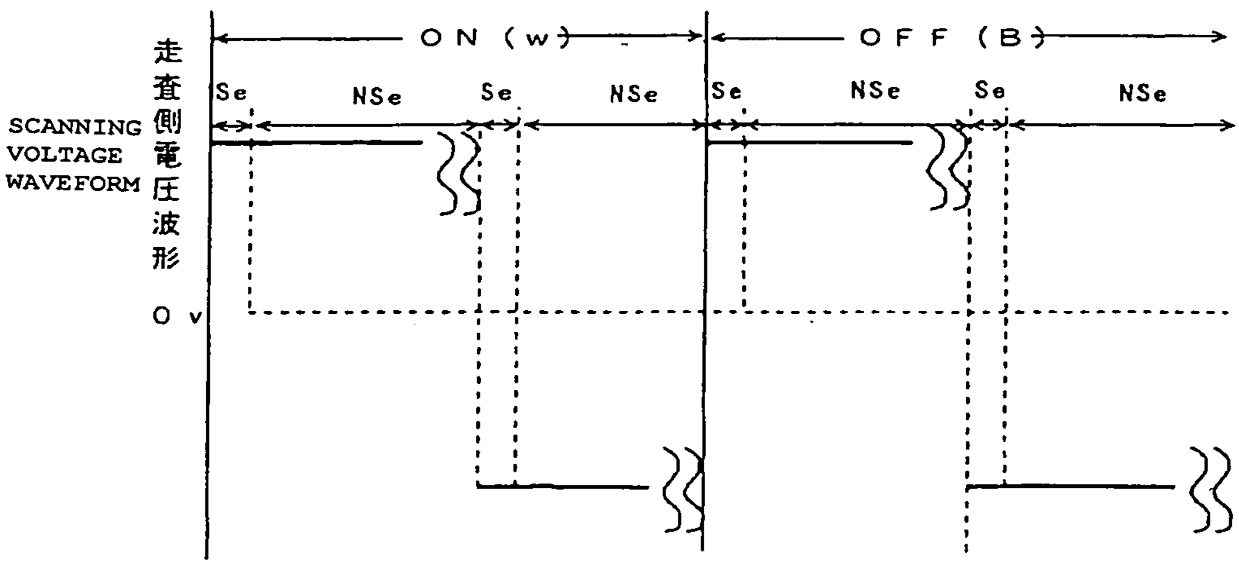
【図７】
[FIG. 7]



【図８】
[FIG. 8]



【図９】
[FIG. 9]



[NAME OF DOCUMENT] ABSTRACT
[ABSTRACT]
[OBJECT] To provide an antiferroelectric liquid crystal display in which a layer structure controlling voltage waveform for preventing image sticking can be output using circuitry which is inexpensive to manufacture and simple in configuration.
[MEANS FOR SOLUTION] The antiferroelectric liquid crystal display has a circuit configuration that can produce a scanning voltage waveform having the same voltage value for both a selection period and a non-selection period and can control the length of a reset period, and prevents image sticking by applying the layer structure controlling voltage waveform for image sticking prevention to a liquid crystal panel.
[SELECTED DRAWING] Figure 1